ANNUAL REPORT FOR 2004

UT to Briery Run Mitigation Site (Crescent Road Site)
Lenoir County
WBS Element 34501.4.1
TIP No. 2719WM

Prepared By:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
March 2005

Summary

The following report summarizes the stream monitoring activities that have occurred during the Year 2004 at the Crescent Road Site in Lenoir County. This site was designed and constructed during 2001 by the North Carolina Department of Transportation (NCDOT) in order to provide mitigation for stream impacts associated with the construction of Crescent Road. This report provides the monitoring results for the first formal year of monitoring (Year 2004); however, it is actually the third year since construction. The Crescent Road Site will be monitored again in 2005. The actual timeline for formal monitoring will be decided by the Mitigation Review Team.

Based on the overall conclusions of monitoring along the UT to Briery Run, the Crescent Road Site has met the required monitoring protocols for the first formal year of monitoring. Localized areas of active bank scour and erosion exist; however, immediate stabilization is not warranted at this time.

Based on information obtained from the USGS, the Crescent Road Site has met the required hydrologic monitoring protocols of two bankfull events. No biological sampling was conducted as part of this monitoring project.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during the Year 2004 at the Crescent Road Site. The site is situated immediately south and adjacent to C.F. Harvey Road (Crescent Road) in the western portion of Lenoir County (Figure 1). It is approximately 2 miles (3.2 kilometers) northeast of Kinston. The Crescent Road Site was constructed as an on-site stream mitigation project in order to provide mitigation for stream impacts associated with the construction of Crescent Road.

The mitigation project covers approximately 2,300 linear feet of an unnamed tributary (UT) to Briery Run. Design and construction was implemented during 2001 by the North Carolina Department of Transportation. Stream restoration involved the installation of rootwads and rock vanes and sloping the adjacent streambanks to reduce overall erosion. It also included the installation of native vegetation.

1.2 Purpose

The objectives for this mitigation site were to improve water quality, riparian quality and stability, and fisheries habitat associated with the UT to Briery Run.

Successful stream mitigation is demonstrated by a stable channel that does not aggrade or degrade over time. It is also demonstrated by reduced erosion rates, the permanent establishment of native vegetation, and bed features consistent with the design stream type. Results of stream monitoring conducted during the 2004 growing season at the Crescent Road Site are included in this report.

Activities in 2004 reflect the first formal year of monitoring following the restoration efforts; however, it is the third year since construction. Included in this report are analyses on stability (primarily the longitudinal profile and cross sections), and site photographs.

1.3 Project History

Summer/Fall 2001	Construction Completed.
October 2004	Stream Channel Monitoring (1 year)

2.0 STREAM ASSESSMENT

2.1 Stream Monitoring Requirements

1) Stream Restoration/Mitigation Success Criteria – NC Division of Water Quality
   a) Duration: 5 years from end of construction (channel modifications and vegetation planted) – based on the fact of 1.4-1.7 year bankfull return period.
   b) Reporting - Three (1st, 3rd, 5th years) Monitoring Reports sent at end of yearly monitoring period to USACOE and the NCDWQ 401 – Wetlands group.

2) Streams – Geomorphology (based on which parameters are restored (dimension, pattern, profile))
   a) Dimension
      1) Permanent Cross-sections (surveyed or GPS) need to be established (1 per 20 bankfull – width) lengths.
      2) Based on reference streams and stream curves.
      3) Measurements: W/D Ratio, Entrenchment Ratio, Low Bank Height Ratio (low bank height/max bankfull depth)
   b) Pattern
      1) Plan View of project site
      2) Based on valley type/stream type
      3) Measurements: Sinuosity, Meander Width Ratio, and Radius of Curvature (on newly constructed meanders only 1st year monitoring)

2.2 Stream Description

2.2.1 Post-Construction Conditions

The mitigation of the UT to Briery Run involved the construction of rock vanes, rootwad revetments, and additional bank sloping. In order to control channel gradient four reinforced concrete box culverts were installed. Native trees and shrubs were also planted to increase bank stabilization.

2.2.2 Monitoring Conditions

The UT to Briery Run was designed to follow E5 stream type morphologies according to the Rosgen Classification of Natural Rivers. For this monitoring report the UT to Briery Creek has been divided into two reaches due to a small section of stream flowing under Crescent Road through a culvert. Monitoring requirements for this site stated cross sections needed to be established 1 per 20 bankfull widths. Based on the requirements a total of nine cross sections were surveyed (four on Reach #1 and five on Reach #2). For this report, only cross sections containing riffles were used for the comparison of channel morphology presented below in Table 1. Data shown in Table 1 includes one cross section chosen to represent a riffle section and minimum and maximum values for the riffle cross sections along the reach.

Table 1. Abbreviated Morphological Summary (Crescent Road Site)

Variable*	UT to Briery Creek (Combined Cross Sections #1, 3 and 4)					
	Proposed	2004		2005	2006	2007
		Cross-Section #3	Min-Max			
Drainage Area (mi^2)	0.21	0.21	0.21	0.21	0.21	0.21
Bankfull Width (ft)	8.9	8.4	5.7 – 8.4			
Bankfull Mean Depth (ft)	0.98	0.8	0.8 – 0.9			
Width/Depth Ratio	9	10.5	6.3 – 10.5			
Bankfull Cross Sectional Area (ft^2)	8.7	6.7	5.1 – 7.2			
Maximum Bankfull Depth (ft)	1.5	1.5	1.5 - 2			
Width of Floodprone Area (ft)	28.9	100	100			
Entrenchment Ratio	3.3	11.9	11.9 – 17.5			
Slope	0.0081		0.007			
Particle Sizes (Riffle Sections)						
D_{16} (mm)		0.071	0.069 – 0.071			
D_{35} (mm)		0.08	0.07 – 0.08			
D_{50} (mm)	0.2	0.1	0.1			
D_{84} (mm)		0	0			
D_{95} (mm)		0	0			

Variable*	UT to Briery Creek (Combined Cross Sections #5, 6, and 9)					
	Proposed	2004		2005	2006	2007
		Cross-Section #6	Min-Max			
Drainage Area (mi^2)	0.24	0.24	0.24	0.24	0.24	0.24
Bankfull Width (ft)	8.9	18.2	10.2 – 18.2			
Bankfull Mean Depth (ft)	0.98	0.9	0.7 – 0.9			
Width/Depth Ratio	9	20.2	11.3 – 23.1			
Bankfull Cross Sectional Area (ft^2)	8.7	16.4	9.2 – 16.4			
Maximum Bankfull Depth (ft)	1.5	2	1.4 - 2			
Width of Floodprone Area (ft)	28.9	100	100			
Entrenchment Ratio	3.3	5.5	5.5 – 9.8			
Slope	0.0062		0.007			
Particle Sizes (Riffle Sections)						
D_{16} (mm)		0.069	0.069 – 0.072			
D_{35} (mm)		0.09	0.07 – 0.09			
D_{50} (mm)	0.2	0.1	0.1			
D_{84} (mm)		0	0			
D_{95} (mm)		0	0			

* Variables without a Min/Max range indicate no range could be referenced.

2.3 Results of the Stream Assessment

2.3.1 Site Data

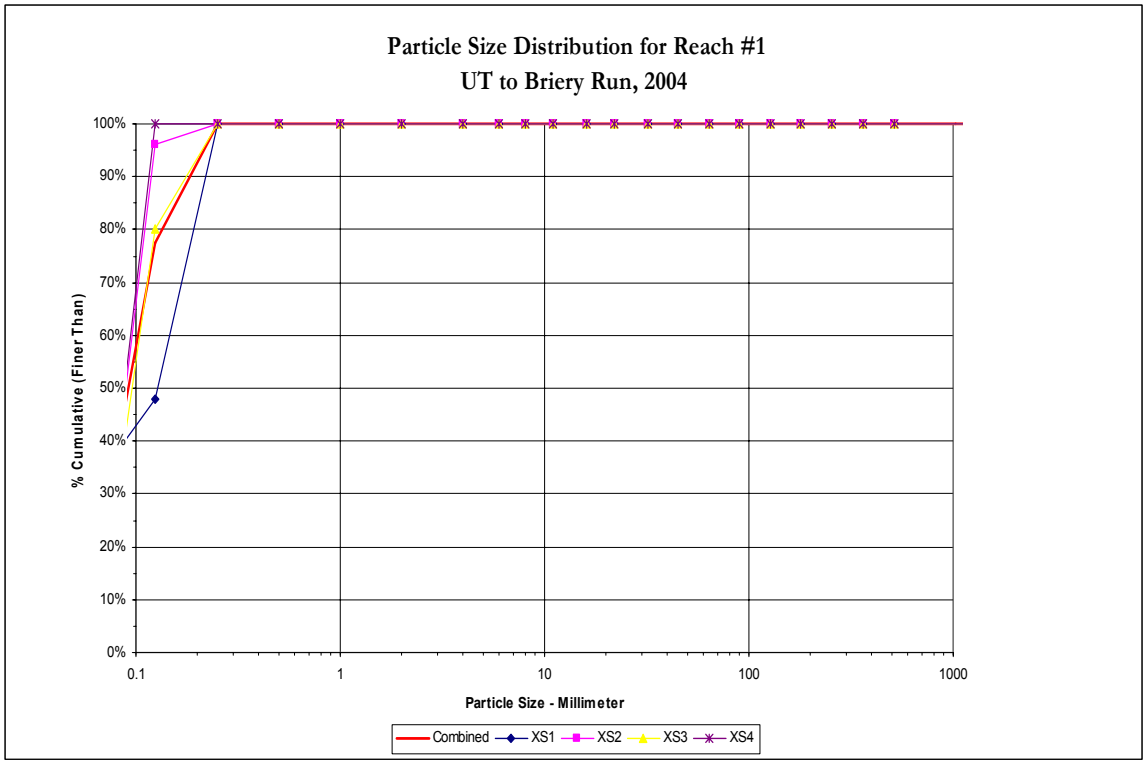
The assessment included the survey of nine cross sections along the two reaches, the longitudinal profile of the UT to Briery Run and the calculations of sinuosity, meander width ratio, and radius of curvature. The length of the profile along the UT to Briery Run was approximately 2,300 linear feet (1,093 linear feet of Reach #1 and 1,188 linear feet of Reach #2). No cross sections had been established prior to the 2004 monitoring year. Cross section locations were subsequently based on the monitoring requirements for this site (1 per 20 bankfull widths) and are presented below. Benchmark stakes were installed on both the left and right stream banks for each cross section location. The locations of the cross sections and longitudinal profiles are shown in Appendix A.

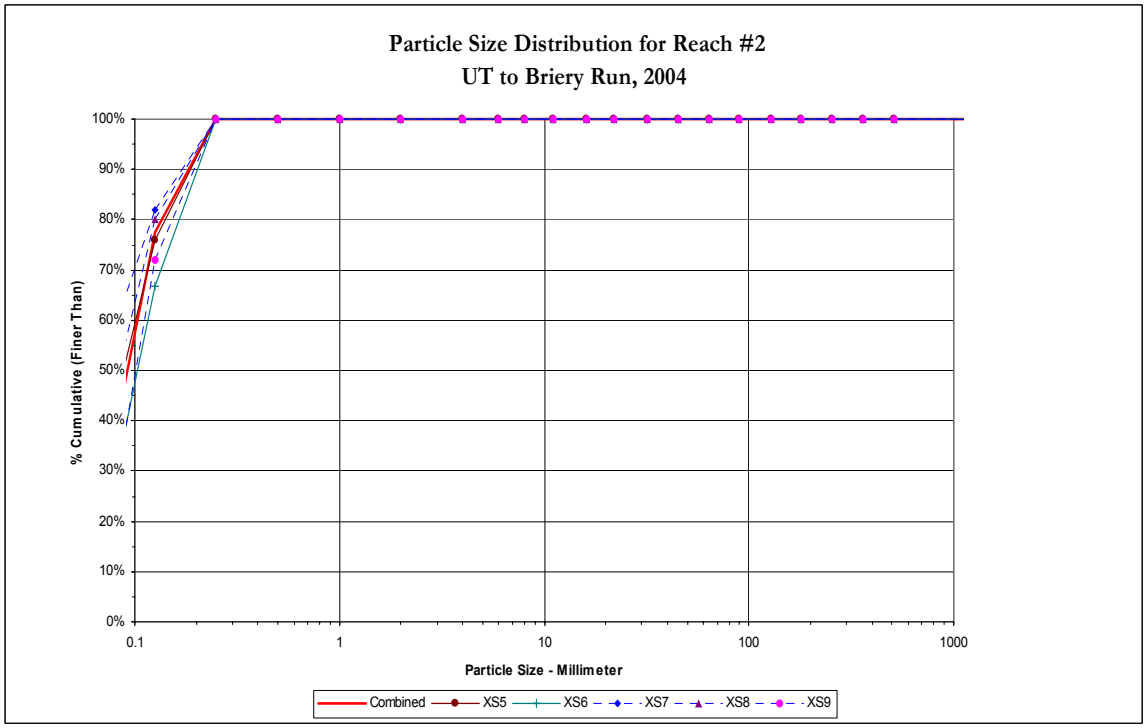
- Cross Section #1. UT to Briery Run, Reach #1, Station 1+96, midpoint of riffle
- Cross Section #2. UT to Briery Run, Reach #1, Station 4+33, midpoint of glide
- Cross Section #3. UT to Briery Run, Reach #1, Station 6+00, midpoint of riffle
- Cross Section #4. UT to Briery Run, Reach #1, Station 8+39, midpoint of riffle
- Cross Section #5. UT to Briery Run, Reach #2, Station 2+00, midpoint of riffle
- Cross Section #6. UT to Briery Run, Reach #2, Station 4+45, midpoint of riffle
- Cross Section #7. UT to Briery Run, Reach #2, Station 6+15, midpoint of run
- Cross Section #8. UT to Briery Run, Reach #2, Station 8+11, midpoint of run
- Cross Section #9. UT to Briery Run, Reach #2, Station 10+62, midpoint of riffle

The cross sections established during the 2004 monitoring survey are being monitored to determine the actual extent of aggradation or degradation and will be compared to future cross section data. All of the cross section locations appeared stable with little or no active bank erosion. Survey data collected during future monitoring periods may vary depending on actual location of rod placement and alignment; however, this information should remain similar in overall appearance. The cross section comparison is presented in Appendix A.

Pebble counts were taken at each cross section as a means to determine the extent of change in bed material during the monitoring period. However, only pebble counts taken at riffle sections will be utilized to classify the stream. Existing data indicated the UT to Briery Creek was a sand-bed stream. The pebble counts taken during the Year 2004 monitoring period noted that the D_{50} (50 percent of the sampled population is equal to or finer than the representative particle diameter) for the riffle sections of UT to Briery Creek was 0.1 mm approximately , which is indicative of a sand-bed stream.

A chart depicting the particle size distributions for the UT to Briery Creek for 2004 is presented below.





A longitudinal profile survey was conducted on the restored segment of the UT to Briery Run. Bank stability was assessed during the cross section and longitudinal profile surveys. Two areas of active scouring were observed in 2004. Active scouring was noted at the

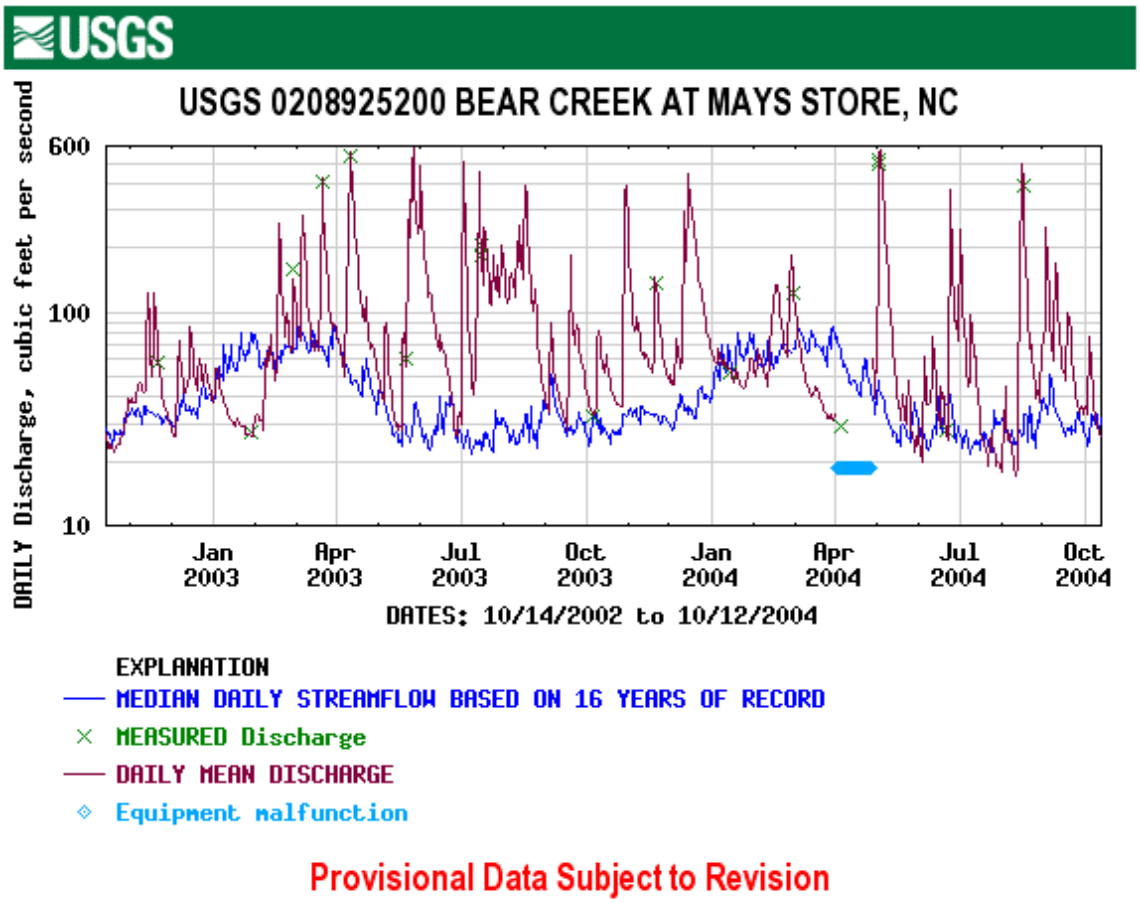
upstream end of Reach #1 from approximately Station 10+00 to Station 10+75. The scouring has caused the streambank to become vertical with little vegetation to aid in stabilization. The other area of active scouring occurs at Station 15+13 on Reach #1. The scouring in this area has undercut the streambank along the right side of the channel, facing downstream. Throughout the two reaches herbaceous vegetation has began to dominate the stream channel. The areas of scouring and the herbaceous vegetation found in the stream will be re-assessed during the next monitoring year to determine if any remedial actions are warranted.

Calculations of sinuosity, meander width ratio, and radius of curvature were made in order to determine the geometry of the UT to Briery Creek. Sinuosity is calculated by dividing stream length by valley length and describes how the stream has adjusted its slope in relation to the slope of the valley. The sinuosity of the UT to Briery Creek is 1.5. The meander width ratio is calculated by dividing the belt width by the bankfull width. The belt width is an index of the lateral containment of a stream when compared with the width of the valley. The meander width ratio for Reach #1 ranges from 2.2 to 12.5 and has mean value of 6.0. The meander width ratio for Reach #2 ranges from 1.2 to 5.5 and has mean value of 3.0. Radius of curvature is expressed as a ratio of the bankfull channel width and is a measure of the tightness of an individual meander. The radius of curvature for Reach #1 ranges from 2.3 to 5.1 and has a mean value of 3.6. The radius of curvature for Reach #2 ranges from 1.4 to 2.9 with a mean value of 1.9.

2.3.2 Climatic Data

Monitoring requirements state that at least two bankfull events must be documented through the five-year monitoring period. No surface water gages exist on the UT to Briery Run. A review of known U.S. Geological Survey (USGS) surface water gages identified two gages within 10 miles (16 kilometers) of the mitigation site: one along the Neuse River in Kinston and one along Bear Creek near Mays Store, approximately 2.5 miles east of the Wayne and Lenoir County boundary.

The Bear Creek gage was utilized for this report since it is the smaller of the two gages (57.7 square-mile drainage area as compared to the 2,692 square-mile drainage area associated with the Neuse River). The Bear Creek gage more accurately reflects hydrology and precipitation in the project area. It is situated in USGS Hydrologic Unit 03020202. Datum of the gage is 50 feet above sea level NGVD29. Based on the drainage area associated with the gage, the correlated bankfull discharge according to the NC Coastal Plain Regional Curves (USACE, 2003) is between 200 and 500 cubic feet per second (cfs). A review of peak flows was conducted for the period between October 2002 and October 2004. According to the graph, there were 4 bankfull events occurring during this period. The USGS graph depicting these peak flows is presented below.



2.4 Conclusions

Overall, the UT to Briery Run remains stable. However, small, isolated areas of erosion do exist along the two reaches as well as extensive growth of vegetation in the stream channel. All nine of the cross sections along the UT to Briery Run are also stable. Based on information obtained from the USGS, the Crescent Road Site has met the required monitoring protocols for hydrology as it relates to bankfull events. No supplemental work is necessary at this time.

3.0 REFERENCES

North Carolina Department of Transportation (NCDOT), 2001. Natural Channel Design for the Crescent Road Mitigation Site, UT to Briery Run, Lenoir County.

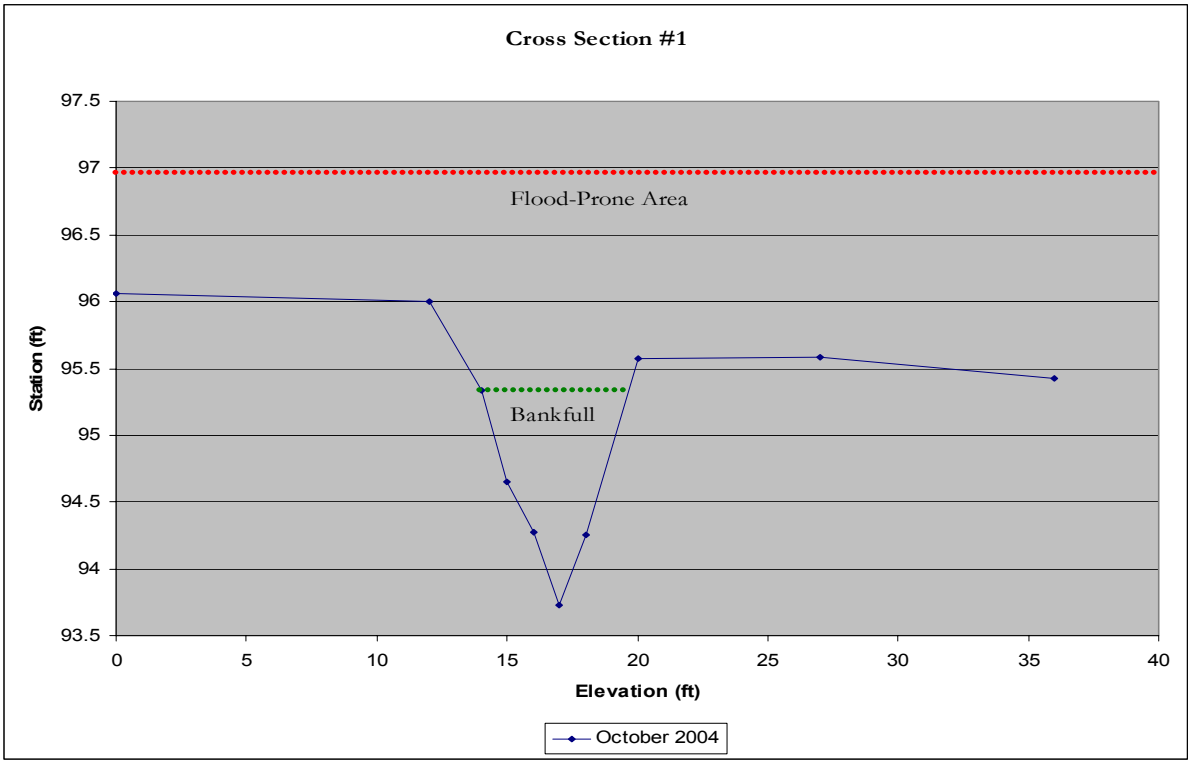
Rosgen, D.L, 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

US Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. Prepared with cooperation from the US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Quality.

US Geological Survey (USGS), 2004. Real-time Data for USGS 03020202 Bear Creek near Mays Store, NC. http://waterdata.usgs.gov/nc/nwis.

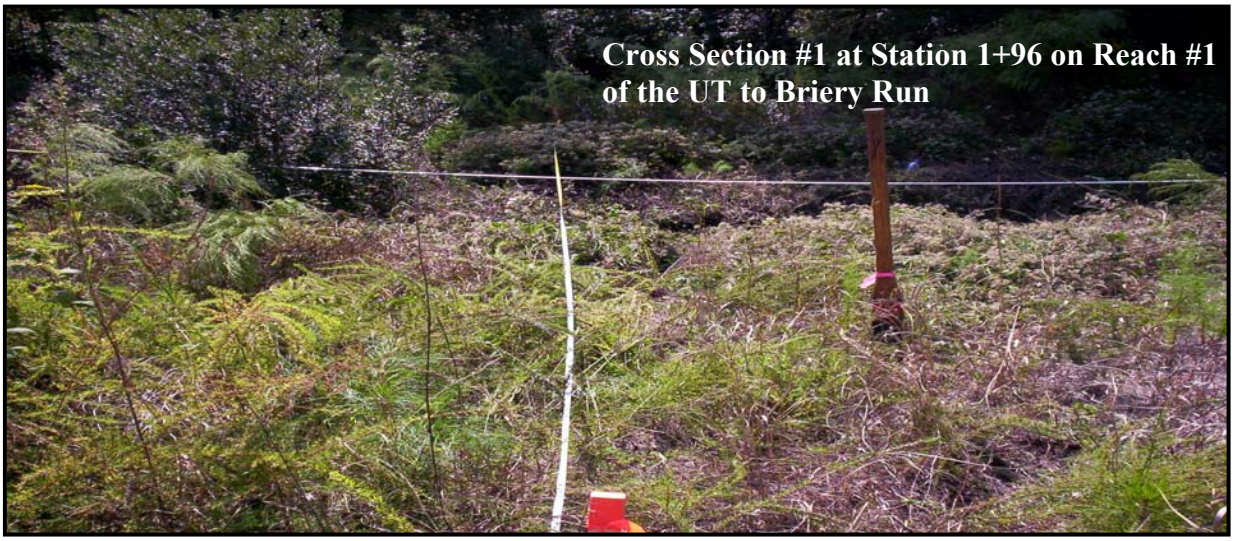
APPENDIX A

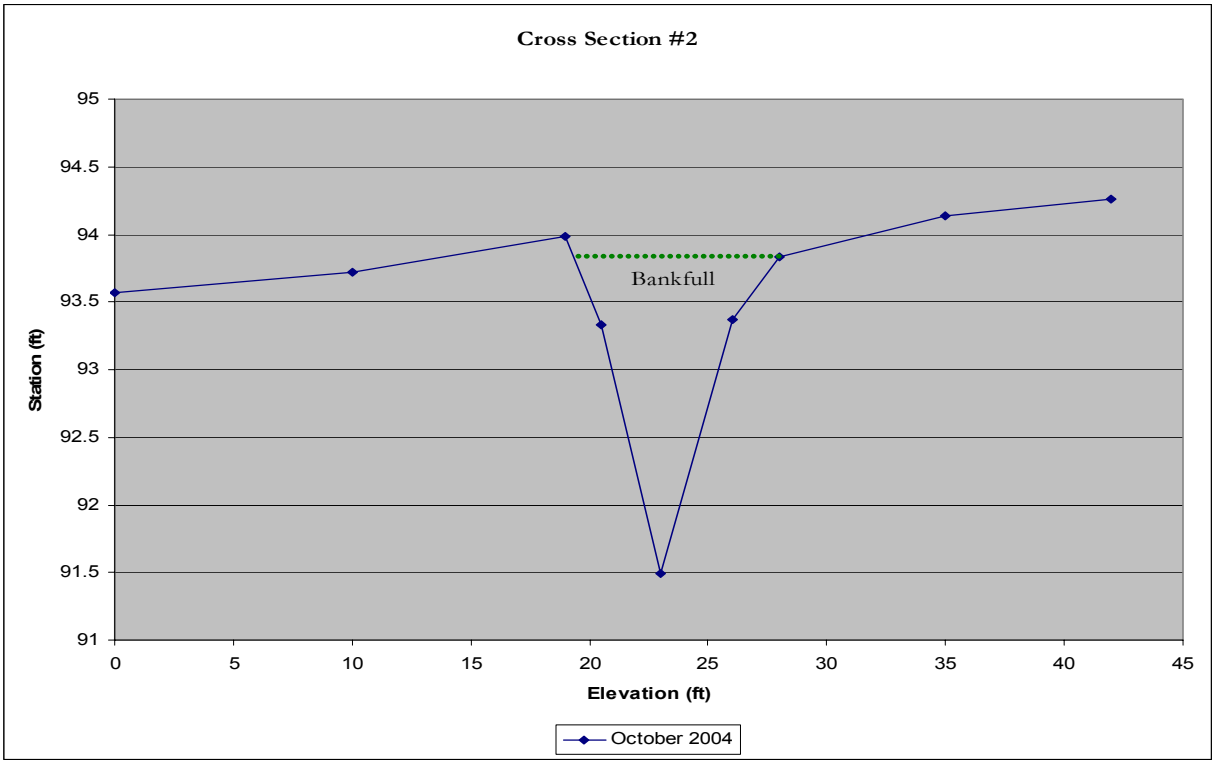
CROSS SECTIONS AND THE LONGITUDINAL PROFILE COMPARISON



Cross-Section #1 (Riffle) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft^2)	5.1				
Maximum Bankfull Depth (ft)	1.6				
Bankfull Mean Depth (ft)	0.9				
Bankfull Width (ft)	5.7				
Width of the Floodprone Area (ft)	100				
Width/Depth Ratio	6.3				
Entrenchment Ratio	17.5				

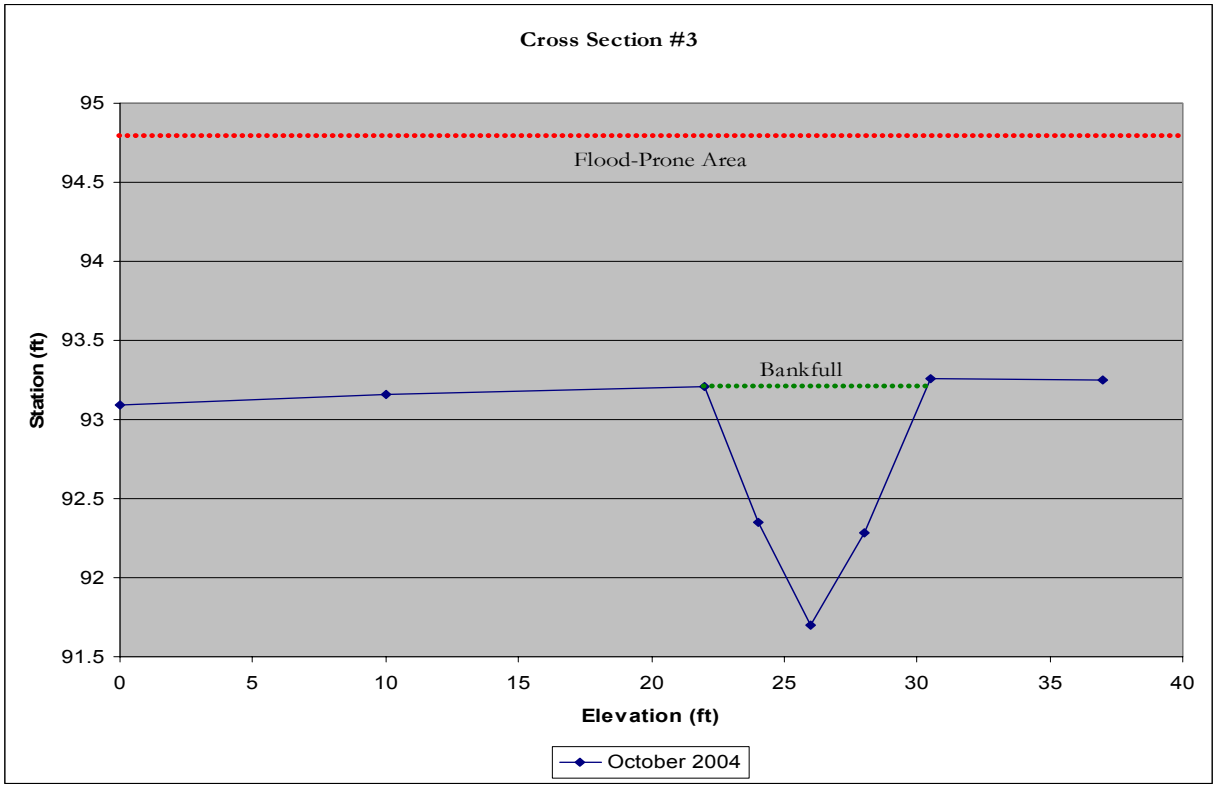




Cross-Section #2 (Glide) Abbreviated Morphological Summary*

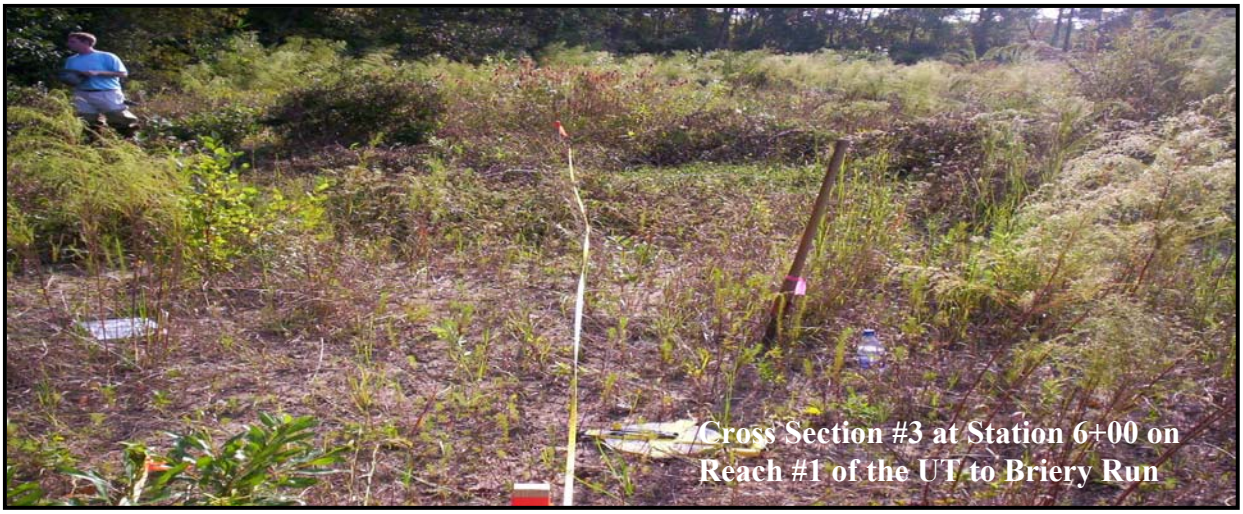
	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft^2)	8.6				
Maximum Bankfull Depth (ft)	2.3				
Bankfull Mean Depth (ft)	1				
Bankfull Width (ft)	8.6				

* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.

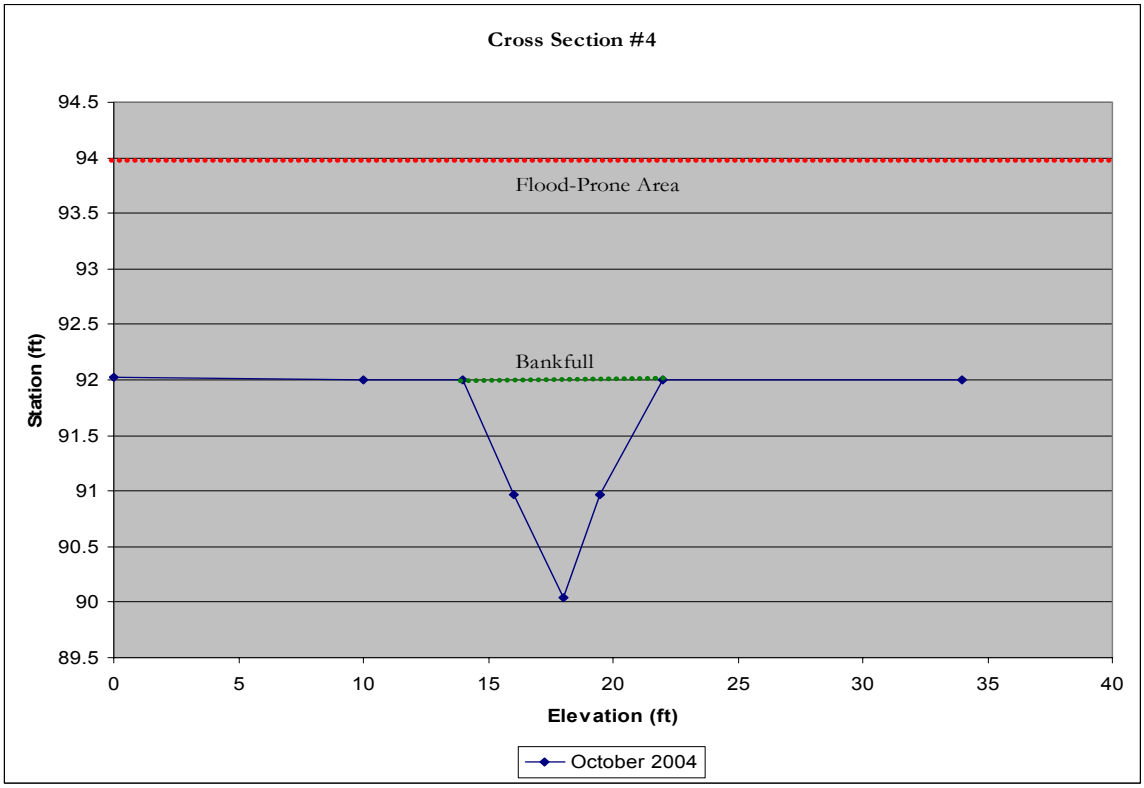


Cross-Section #3 (Riffle) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft^2)	6.7				
Maximum Bankfull Depth (ft)	1.5				
Bankfull Mean Depth (ft)	0.8				
Bankfull Width (ft)	8.4				
Width of the Floodprone Area (ft)	100				
Width/Depth Ratio	10.5				
Entrenchment Ratio	11.9				



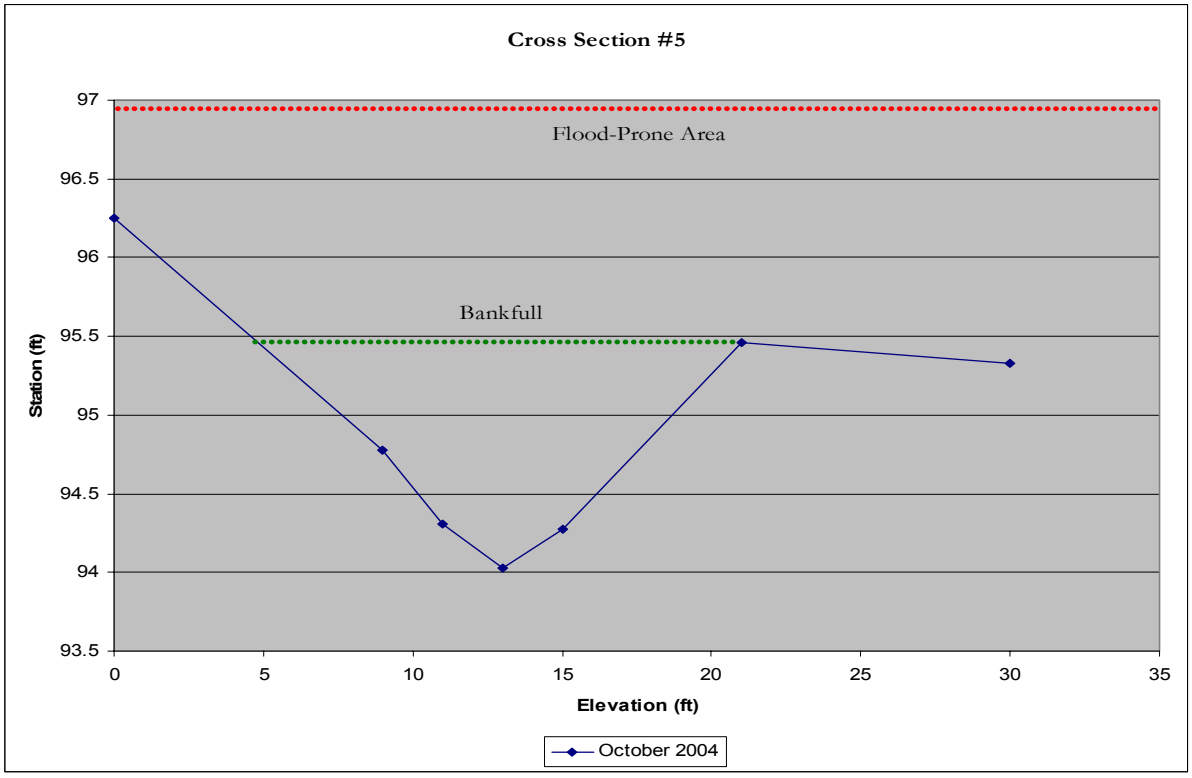
Cross Section #3 at Station 6+00 on Reach #1 of the UT to Briery Run



Cross-Section #4 (Riffle) Abbreviated Morphological Summary

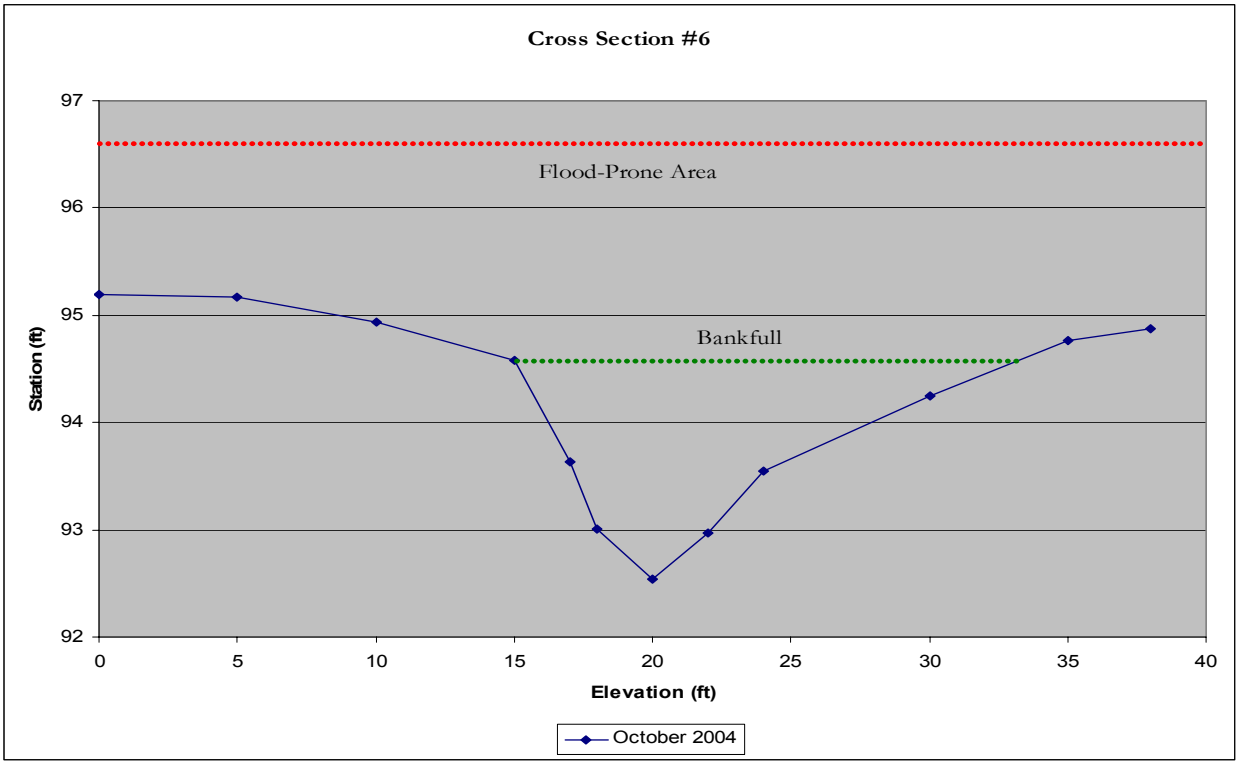
	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft^2)	7.2				
Maximum Bankfull Depth (ft)	2				
Bankfull Mean Depth (ft)	0.9				
Bankfull Width (ft)	8				
Width of the Floodprone Area (ft)	100				
Width/Depth Ratio	8.9				
Entrenchment Ratio	12.5				

Cross Section #4 at Station 8+39 on Reach #1 of the UT to Briery Run



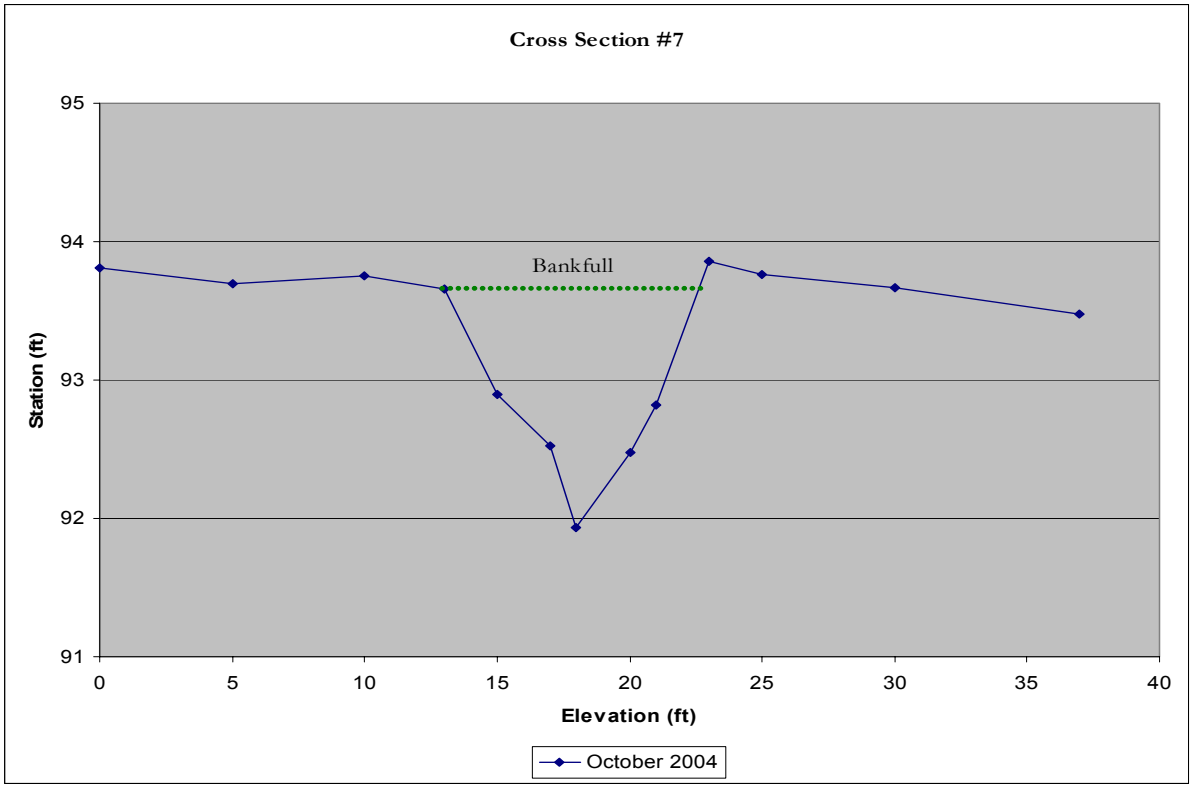
Cross-Section #5 (Riffle) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft^2)	11.3				
Maximum Bankfull Depth (ft)	1.4				
Bankfull Mean Depth (ft)	0.7				
Bankfull Width (ft)	16.2				
Width of the Floodprone Area (ft)	100				
Width/Depth Ratio	23.1				
Entrenchment Ratio	6.2				



Cross-Section #6 (Riffle) Abbreviated Morphological Summary

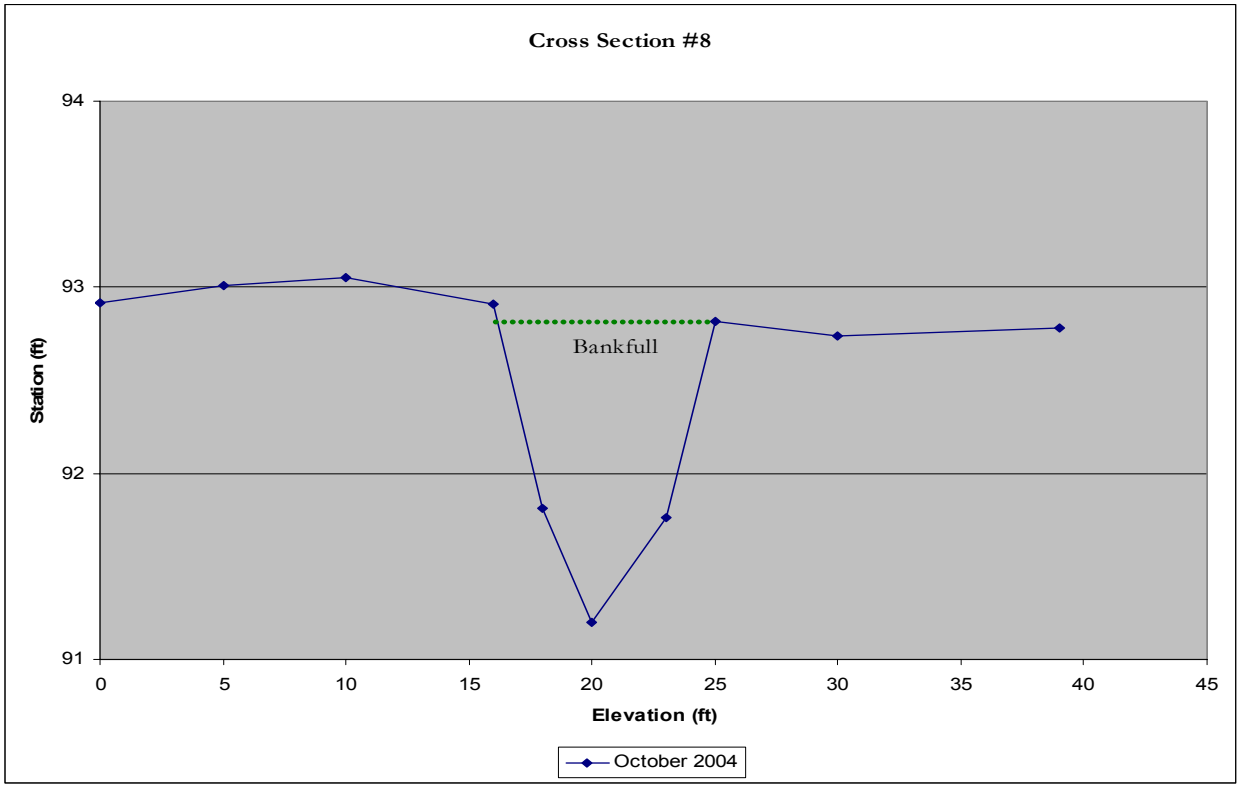
	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft²)	16.4				
Maximum Bankfull Depth (ft)	2				
Width of the Floodprone Area (ft)	100				
Bankfull Mean Depth (ft)	0.9				
Width/Depth Ratio	20.2				
Entrenchment Ratio	5.5				
Bankfull Width (ft)	18.2				



Cross-Section #7 (Glide) Abbreviated Morphological Summary*

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft^2)	9.7				
Maximum Bankfull Depth (ft)	1.7				
Bankfull Mean Depth (ft)	0.6				
Bankfull Width (ft)	16.2				

* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.

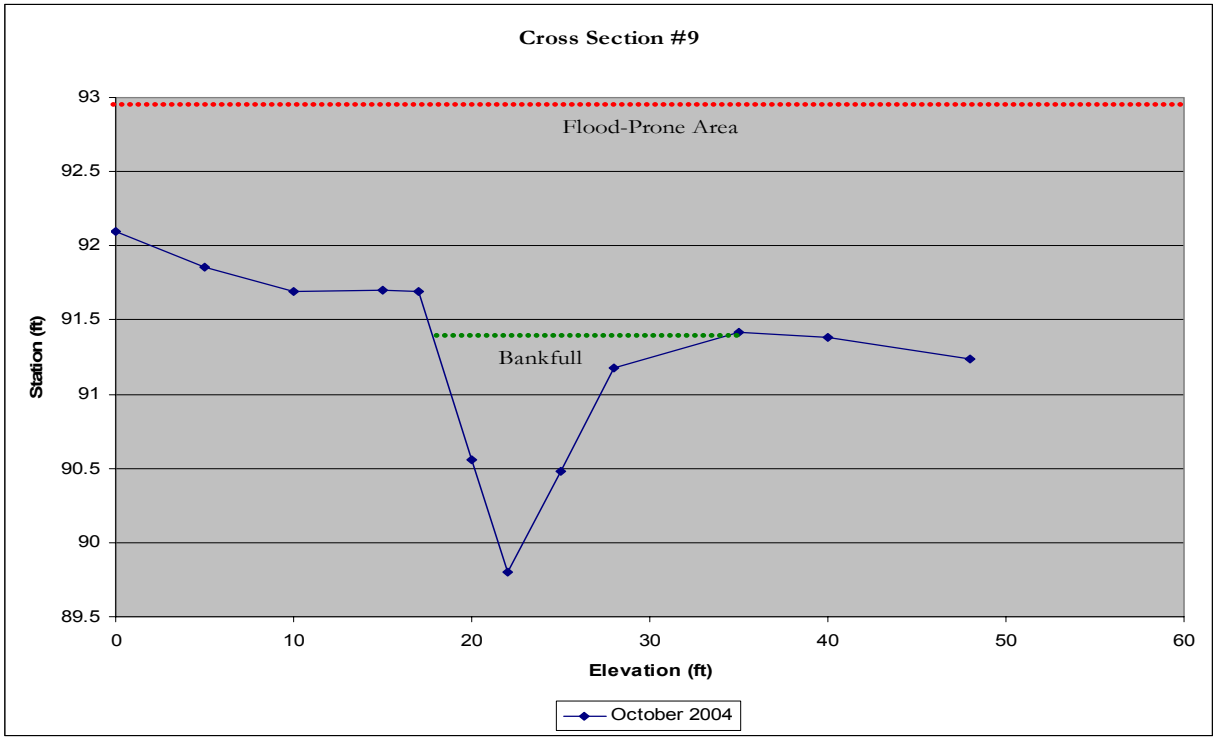


Cross-Section #8 (Glide) Abbreviated Morphological Summary*

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft^2)	8.8				
Maximum Bankfull Depth (ft)	1.6				
Bankfull Mean Depth (ft)	1.0				
Bankfull Width (ft)	8.8				

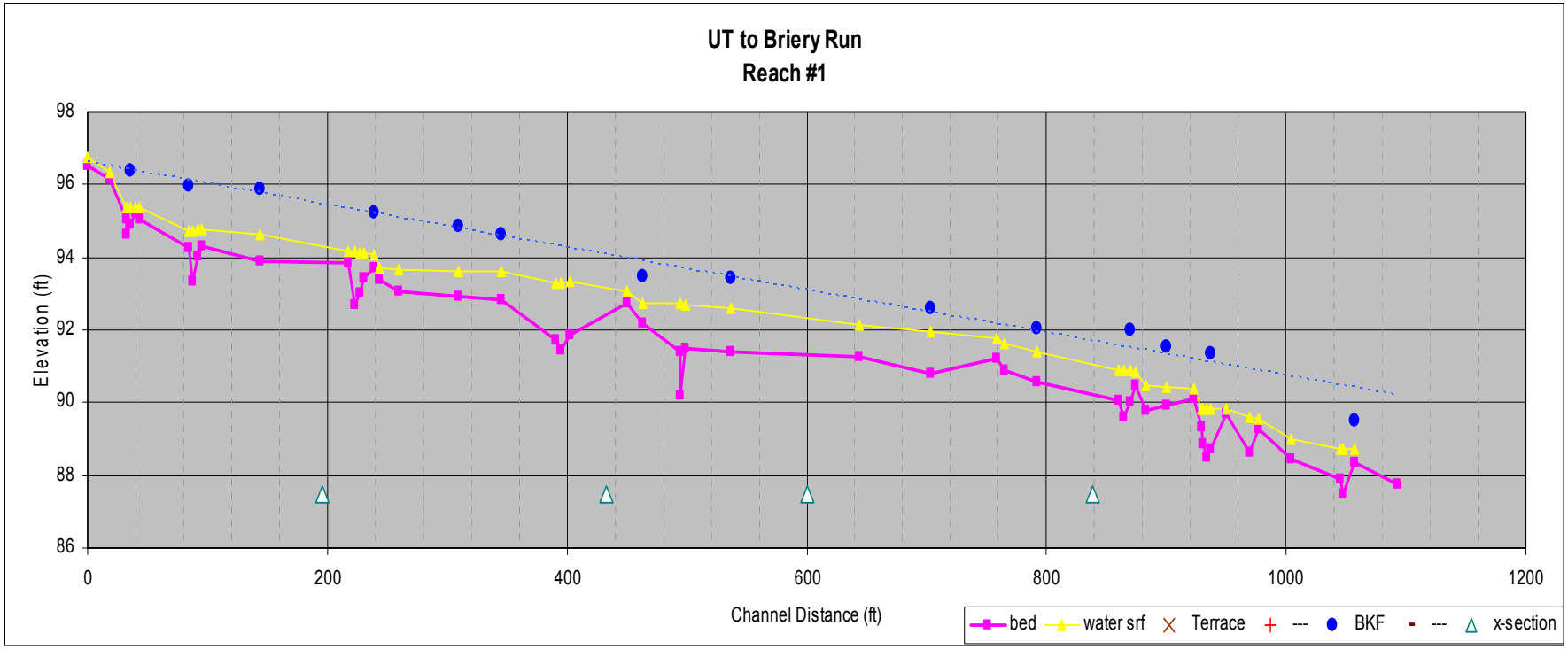
* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features.

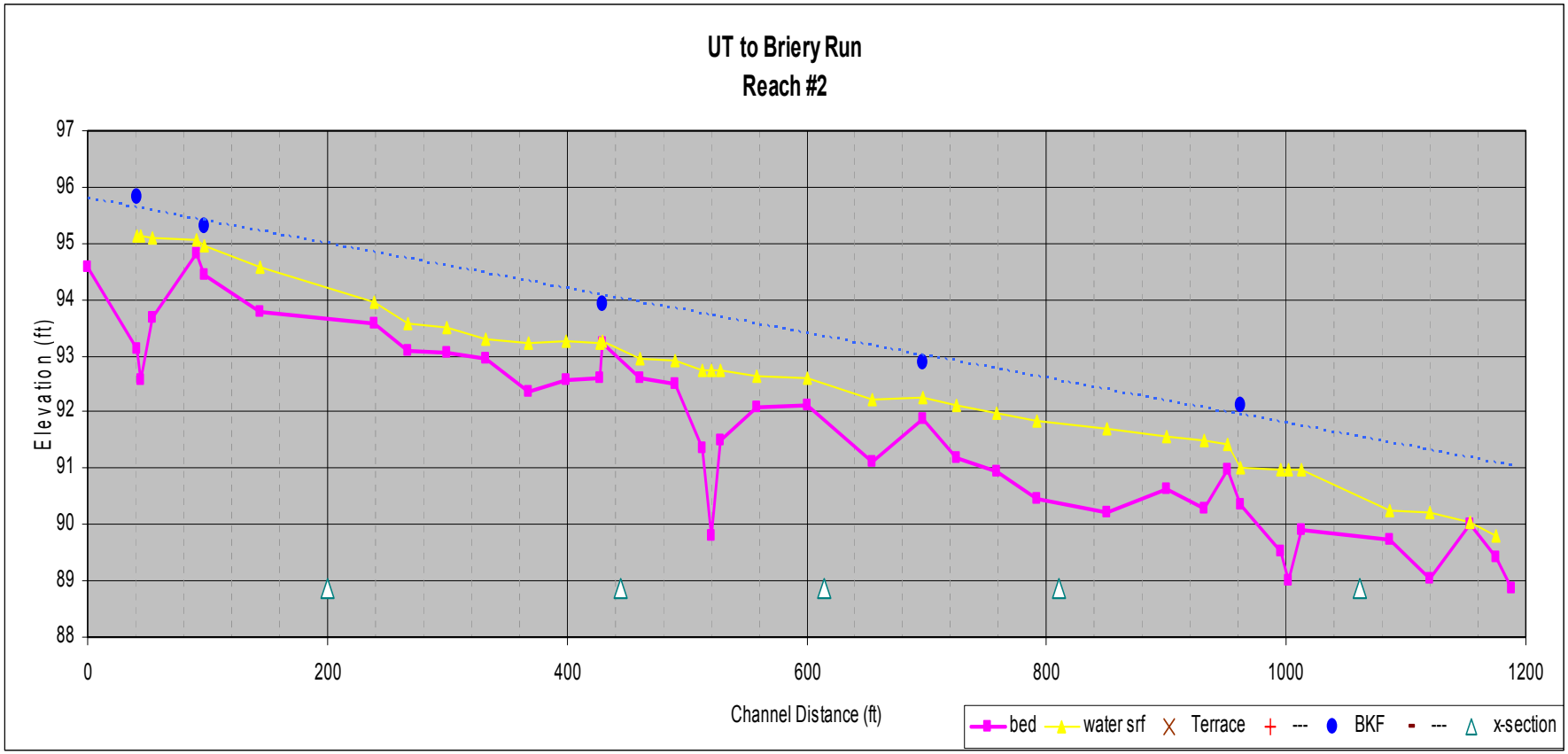
Cross Section #8 at Station 8+11 on Reach #2 of the UT to Briery Run



Cross-Section #9 (Riffle) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft^2)	9.2				
Maximum Bankfull Depth (ft)	1.6				
Bankfull Mean Depth (ft)	0.9				
Bankfull Width (ft)	10.2				
Width of the Floodprone Area (ft)	100				
Width/Depth Ratio	11.3				
Entrenchment Ratio	9.8				


UT to Briery Run
Reach #1
Elevation (ft)
98
96
94
92
90
88
86
0
200
400
600
800
1000
1200
Channel Distance (ft)
bed
water srf
Terrace
BKF
x-section


UT to Briery Run
Reach #2
Elevation (ft)
97
96
95
94
93
92
91
90
89
88
0
200
400
600
800
1000
1200
Channel Distance (ft)
bed
water srf
Terrace
BKF
x-section

APPENDIX B

SITE PHOTOGRAPHS

PHOTO POINTS – REACH #1

PHOTO POINTS – REACH #1 continued

Looking upstream from culvert in downstream end of Reach #1

Overview of Reach #1 – looking upstream

PHOTO POINTS – REACH #2


Photo Point #4 - Upstream


Photo Point #4 - Downstream


Photo Point #5 - Upstream


Photo Point #5 - Downstream


Photo Point #6 - Upstream

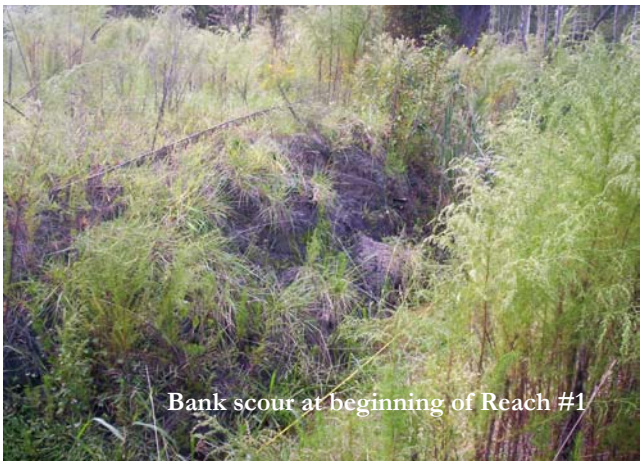

Photo Point #6 - Downstream

PHOTO POINTS – REACH #2 continued

Overview of Reach #2 - Upstream

Overview of Reach #2 - Downstream

UT TO BRIERY RUN



Bank scour at beginning of Reach #1

Bank scour at Station 15+13 of Reach #1

Vegetation in stream channel